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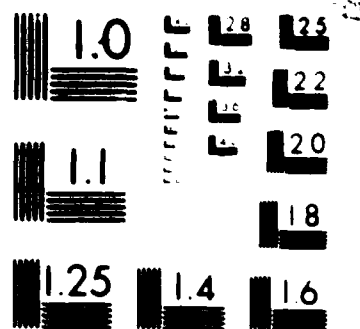
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This instrumentation award was used to purchase a masscomp 5700 computing system with multiple, tightly-coupled microprocessors. The system will be used for the requisition, analysis, control and display of data obtained in real time from several neurons in a simple invertebrate nervous system for the purpose of gaining insight into how nervous systems process information. The system as originally ordered was finally installed on October 27, 1986.			
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FINAL REPORT  
ON DoD INSTRUMENTATION AWARD  
November 14, 1986

**TO:** John T. Campellone, 2 Lt, USAF  
Contract Negotiator  
Department of the Air Force  
Air Force Office of Scientific Research  
Bolling Air Force Base, DC 20332-6448

**AFOSR-TR. 87-0027**

**FROM:** Dr. Herbert Levitan  
Project Director  
Department of Zoology

and

Dr. N. DeClaris  
Co-Principal Investigator  
Department of Electrical  
Engineering

*Herb Levitan*

University of Maryland  
College Park, MD 20742  
(301) 454 6579

**RE:** Final Report on DoD Instrumentation Award AFOSR-85-0135

**Title:** Microcomputer-based Data Acquisition, Analysis and Control of  
Information Processing by Neural Networks

University Account No.: 01-5-28111

**Abstract:**

This instrumentation award was used to purchase a computing system with multiple, tightly-coupled microprocessors. The system will be used for the acquisition, analysis, control and display of data obtained in real time from several neurons in a simple invertebrate nervous system for the purpose of gaining insight into how nervous systems process information. This final report describes the configuration and characteristics of the system that was purchased, and documents the events that have lead to long delays in its installation. The system as originally ordered was finally installed on October 27, 1986.

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Chief, Technical Information Division

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21 NOV 1986

In accordance with the reporting requirements of the above award we describe below the progress we have made in acquiring the instrumentation to carry out our proposed research.

**1. Research problem and objectives:**

We are interested in gaining insights into how nervous systems process information. Toward this end we need to acquire data on the concurrent status of several neurons in a network, and subject these data to an on-line analysis that will reveal the identity of the neurons, how these neurons are coupled to others, which neurons serve a sensory function and which are output neurons, etc. On the basis of this information, selected neurons or sensory inputs will be stimulated in a manner that is predetermined by referring to a previously constructed data base. Analysis of the response of the ensemble should allow us to deduce which neurons in the network mediate reflex responses and which control throughput.

To achieve these objectives we have attempted to procure the most technically advanced system possible within the financial constraints of the instrumentation award. The system allows for high speed analysis of data from several sources in real time, and the creation and maintenance of a knowledge base which could be used to make decisions about the experiments that should be performed next in order to maximize the yield of useful information from a given experimental condition. The realization of such an advanced neurophysiological workstation should not only prove useful for analyzing how information is processed by nervous systems but complement efforts by others developing fifth generation computing systems with similar artificial intelligence.

**2. Instrument acquired and specific circumstances regarding its acquisition.**

A history of our complex and protracted negotiations with two manufacturers of systems we thought would meet our needs is described in the Interim Progress Report submitted July 31, 1985. In September 1985 we decided that the Masscomp Model 5700 system would meet our needs and our financial constraints, and a request for bids on such a system went out in October 1985. After straightening out several discrepancies that appeared between the price bid and the price agreed upon in correspondence with Masscomp prior to the bidding process, the decision was made to submit a purchase order for the 5700 system. Delivery of the complete dual-processor configuration was promised by the end of 1985.

Unexplained difficulties delayed delivery of the system however, and it was not until April 1986 that a system was delivered to the Neurophysiology Laboratory in the Zoology Department. Moreover, upon installation it was discovered that only one of the two central processing units ordered was included in the shipment. Inquiries as to when the second cpu could be expected were unanswered. In June 1986 we were informed by Masscomp that the warranty had expired on the system and we were no longer eligible for on-site or telephone service concerning difficulties we were experiencing as we attempted to systematically test the unit. After writing to several vice presidents that our purchase agreement included an extended warranty that should go for 180 days from the time the complete system is installed, we received on July 18, 1986, a letter reaffirming the intent of the warranty

arrangement as we originally understood it.

Finally, in October 1986, we were informed that the second cpu was available for delivery and that we should backup the contents of the hard disk in case unforeseen problems occurred when the cpu was installed. During the backup procedure however, so many transmission errors were detected that we suspected a serious problem existed in the original system. Upon further inquiry it was determined that the manufacturer of the hard disk had notified Masscomp that a batch of hard disks they had delivered was inadequately coated, and that the one installed in our machine was among the bad batch.

On October 27, 1986, the hard disk was replaced and the second cpu installed. Thus the system ordered in November 1985 appears to be completely installed, finally. We are now testing it to assure ourselves that it meets our specifications.

The system as currently configured consists of:

<u>Item</u>	<u>Cost</u>
Dual 32-bit MC 68020 CPUs, each associated with:	
Floating point co-processor MC 68881	
8 Kb virtual cache	
2 Mb Random access memory	
3 RS232 serial ports	
Virtual memory management	
Storage devices include:	
165 Mb Hard Disk (Fujitsu M2322)	
1 Mb floppy disk (Teac FD 55F)	
45 Mb 1/4 inch tape drive (Scorpion 5945C)	
Input/output devices include	
Independent graphics system with dedicated MC 68000 cpu	
19 " color monitor (832x600x6 resolution)	
Key board	
Mouse	
16 single-ended 12-bit A/D converters with 1 MHz sampling rate	
8 12-bit D/A converters with 500 kHz sampling rate	
Software includes:	
Unix based operating system that is a combination of AT&T System V and Berkeley Unix 4.2 BSD, with additions to allow for real time and multiprocessing operations.	
Data presentation application software	
Graphics application software	
Fortran and C compilers	
TOTAL SYSTEM COST	\$79,875.
DoD contribution	61,186.

### 3. Current activity:

Now that the system we ordered has been finally installed we are in a position to a) test that it meets the stated specifications, b) learn how to use it to accomplish the research goals we have stated at the beginning of this report, and c) submit proposals to agencies who are interested in supporting research in this rapidly advancing field.

Personnel involved in the project include Mr. Robert Bennington, a captain in the Air Force, and a doctoral candidate in the Electrical Engineering Department. His initial task is to study the capabilities and limitations of the Model 5700, to determine, for example, how such a dual-processor system handles simultaneous requests for the same memory space, how priorities are set, how the main memory is updated when the separate cache memories are updated, how processing is distributed between the two cpus, etc. Subsequently algorithms will be developed to accomplish the various data processing, display and control tasks that we wish to carry out in real time.

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